REDUCTION OF DISLOCATIONS.

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PREFATORY NOTE.

To the Editor of the Boston Medical and Surgical Journal.

Dear Sir,—Nearly two years ago I began the preparation of a paper upon the Reduction of Dislocations, which ill health prevented my finishing.

This work was undertaken both from an inclination on my own part to place before the profession doctrines which I deem of great importance, and also in accordance with the often expressed wish of many of my pupils that I should put on record views which they have found so valuable after testing them in practice.

With returning health I find my disposition for the work revived, while my conviction of its importance has been deepened by additional reflection and experience.

I have, therefore, written this paper, which, imperfect as I know it to be in its treatment of the subject, having been prepared amidst the constant pressure of other labor, contains ideas that I feel sure are worthy of the careful attention of my professional brethren.

W. W. G.

Portland, Oct. 25, 1869.

REDUCTION OF DISLOCATIONS.

In the discussion of this subject I shall confine myself to the consideration of two main questions.

1st, What is the principal obstacle encountered in our efforts at reduction?

2d, What rules of procedure should guide us in the treatment of these injuries?

If an answer to the first question is sought for in the surgical text books of the day, it will be seen that *muscular resistance* is universally deemed to be the great hindrance to reduction, and upon this idea are based the various methods of treatment recommended by surgical writers, from Hippocrates down to the present time. It is true that some authors admit other subordinate agencies, and Gross, with a characteristic breadth of view, attaches much importance to the great ease with which luxations are occasionally reduced even in muscular subjects, and on the other hand to the great difficulty oftentimes experienced in relieving these deformities even after complete muscular relaxation has been produced by venesection, nauseants and anæsthetics; and he argues that the catching of the head of the bone under the muscles and tendons, the small size of the aperture in the capsule through which it has escaped, and the interlocking of the various prominences and depressions so common in the vicinity of articulations and so marked in certain localities, must occasionally prove serious obstacles to reduction. Still he does not, nor, so far as I know, do any of the systematic writers on surgery recognize these conditions as other than occasional and minor in their operation. I think conclusive evidence of professional opinion on this subject, at the present time, may be found in the last edition of Erichsen's Surgery, the American reprint of which Mr. Lea of Philadelphia has issued within four months past. This really excellent work, which in most respects is fairly up to the times, may be assumed to teach the modern views and practices of the great majority of surgeons; and in the chapter on Dislocations, under the head of Treatment, page 291, the author makes this plain and unqualified statement. "The great obstacle to reduction is the *tonic contraction of the muscles* inserted into or below the displaced bones, and the surgeon's efforts are chiefly directed to overcome this contraction."

As my own belief and corresponding practice is diametrically opposed to this statement, I will first state it, and then indicate the line of thought through which I was brought to my conclusions.

Since February, 1856, I have believed and taught, for the last nine years publicly, as my classes in Berkshire Medical College, the Medical School of Maine and the University of Michigan can testify:—

1st, *That the main opposing force to the reduction of dislocations is the untorn portion of the capsular ligament.*

2d, *That in our efforts at reduction the primary object should be the relaxation of the untorn portion of this ligament, and that whatever mode of procedure accomplishes this with most facility is the best.*

3d, *That occasionally the small size or peculiar shape of the rent in the capsule, or, in peculiar conditions of the nervous system, muscular contractions, may constitute the major forces with which we have to deal; but that these cases are so extremely rare as not at all to invalidate the general rule.*

I desire at this point to call attention to the fact that these propositions are not restricted to special dislocations, either as regards locality or variety, but apply to this class of injuries generally.

When a student of medicine in 1852 I became acquainted with Dr. Reid's views, then just published, upon reduction of the upward and backward dislocation of the head of the femur by manipulation. In a conversation upon the subject with my venerable friend, the late Dr. Young B. Walker, of Waterford, Me., he informed me that he had repeatedly effected reduction by a similar procedure which he learned from his preceptor, Prof. Nathan Smith, whom he had seen practise it successfully. He also said that Dr. Smith's explanation of the success of the method, as well as his own, accorded with that of Dr. Reid in attributing it to muscular relaxation.

In the winter of 1854–5 it was my privilege to be under the instruction of that excellent surgeon and teacher, Prof. Moses Gunn, now of Rush Medical College, Chicago.

He taught at that time *that in the several luxations of the head of the humerus*, and in the *upward* and *backward displacement of the caput femoris*, the *untorn portion of the capsule* was the main obstacle to reduction, and so far as the hip was concerned, he demonstrated his theory before his class upon a cadaver, having the articulation entirely cleared of surrounding muscles. Professor Gunn took, and ably defended the same position, in a paper published in the *Peninsular Journal of Medicine* in September, 1855, also published in the *New York Journal of Medicine*, and in a subsequent article, in which a part of the first paper was reproduced, which appeared in the *Peninsular Journal* in May, 1855.

It will be observed that while Dr. Gunn applied the same principle to the several luxations of the shoulder as to the one of the hip above mentioned, and while he differed entirely from Smith and Reid in his explanation of the remarkable ease of reduction by manipulation, putting ligamentous tension in place of muscular contraction, he yet like them confined the application of the principle, in the coxo-femoral articulation, to the *upward* and *backward* luxation; and in reply to my question whether the other dislocations of this joint might not be treated upon the same theory, he said he thought not.

These were the sources and this the extent of my knowledge upon the subject of reduction by manipulation and the claim of untorn ligament for consideration when I entered upon practice; nor have I from that time to this seen or heard anything further about the matter, outside of my own investigations, except the remarks of Prof. Busch in the Year Book of the Sydenham Society for 1863, in which he attributes the resistance in hip luxations to ligament instead of muscle. I should add, that while I have no knowledge of such fact from Prof. Gunn himself, I have been told by several students that he now extends the principle to the several coxo-femoral displacements.

I became firmly possessed with the idea that so important a principle as this had been shown to be in connection with certain luxations, must have a more general application, and within a few months after graduating I had a case of dislocation of the *caput femoris* forward and upward upon the pubis, that I reduced with my own hands without the aid of anæsthetics.

A few weeks later I saw a backward and outward luxation of the elbow in a lady 40 years old. I directed extension to be made in the line which the forearm then occupied, being the ordinary angle of flexion seen in this injury; this was done by first one, then two and finally three men pulling upon a towel attached at the wrist, while counter extension was made upon the arm just above the elbow, but without avail, the patient being meantime profoundly etherized. I now directed the assistants to cease their efforts, and seizing the arm firmly just above the elbow with my left hand, and the forearm with my right, I flexed the limb, making at the same time slight extension and rotation, and the deformity was immediately relieved. I argued with myself that if the resistance was principally or entirely muscular the powerful extension was certainly sufficient to overcome it, and that at any rate its action upon the muscles simply, was greater than the subsequent *effectual* movements of the limbs made by my own hands. Soon after this, in conversation with Dr. Daniel Towne, of Lowell, he alluded to the case of a man killed by machinery, who with other injuries sustained a dislocation of the elbow. The Doctor was called to put the mangled remains in as decent condition as possible for burial, and among other things reduced the luxation, "and," said he, "it required as much force to set those bones *as if he had been alive.*" He also assured me that he saw the body before *rigor mortis* occurred.

These several cases strengthened my suspicion that in *all forms of dislocation* ligament and not muscle was the offending agent, and in the following winter I im-

proved an opportunity to make such observations *post mortem* upon the articulations of the elbow, wrist and phalanges as convinced me of the truths embodied in the propositions already laid down.

In considering the relative importance of ligamentous and muscular resistance to reduction the following facts should be well pondered:—

1st. The shafts of the long bones are, as a rule, surrounded by groups of muscles quite as powerful in their combined action as are those that envelope their articulations.

2d. In fractures of the shaft, with displacement of its mobile fragments whose sharp and ragged ends are constantly provoking muscular spasm, which increases its own cause, the amount of "contraction" is at least equal to that resulting from the displacement of its smooth and rounded articular extremity, which occupies a fixed position.

3d. In the various fractures (not impacted) occurring in the arm, forearm, thigh and leg, the cases are very rare in which the surgeon is not able, with his own hands, to make sufficient extension for the relief of the deformity, thus overcoming, of course, muscular contraction, even without anæsthetics, his main difficulty being to retain the fragments in proper apposition; while in dislocations, effective extension in the ordinary mode often requires the force of several men or of the compound pulleys.

4th. Profound anæsthesia annuls muscular resistance. But while it allows the fragments of a fractured bone to be replaced with the utmost facility, it oftentimes fails to diminish in any appreciable degree the difficulty of reducing dislocations, the most powerful extending force, if applied in the ordinary manner, still being required.

5th. It frequently happens that dislocations occurring in strong men, where there is no evidence of extraordinary muscular injury, are reduced with great ease by the rules laid down in the books, without anæsthetics, and when the muscles are seen and felt to be in a state of positive resistance.

It would seem that such considerations as these should long ago have taught surgeons that an opposing force so constant under the varying conditions of muscular activity and repose, and again occasionally found wanting where vigorous muscles are known to be in a state of resistance, must be ligamentous. But I apprehend that here, as in other departments of thought, progress has been hindered by that too prevalent habit of observation and reasoning by which selection is made of such evidence as seems to substantiate a theory, while facts which, viewed in the light of the theory, occupy equivocal or mysterious ground, are ignored or passed lightly by. The world is full of doctrines, both in and outside of Medicine and Surgery, that can claim only this kind of support.

Upon the theory that muscular contraction is the most powerful opposing force to reduction, a very large proportion of the difficult cases must remain unexplained. But upon the assumption that the untorn portion of the capsule is the principal agent with which we have to deal, everything becomes clear, even from a theoretical standpoint alone, the exceptional cases, as will be clearly seen, I trust, before I close, proving the rule; and when we add the positive demonstrations upon the cadaver, *stripped of its muscles*, that, excluding such cases as have already been and will hereafter be alluded to, and which are equally important as corroborating this view, untorn ligament does accurately and constantly determine the characteristic deformity of the various luxations, and that, before reduction can be effected, this *firm, dense, inelastic structure must either be torn through or relaxed*; and furthermore, that by the time-honored method of extension and counter-extension the laceration is necessarily completed before the deformity can be relieved, the proof would seem complete.

With the exception of two years, I have, since 1856, annually repeated these demonstrations in the dissecting-room, under the observation of private students and of members of the profession, and in ten successive courses of lectures have given the same illustrations more or less fully before my classes in the lecture-room.

Among many gentlemen who have kindly assisted me while pursuing these studies, I am especially indebted to my former pupils, Drs. E. B. Lyon of Palmer, Mass., F. K. Paddock of Pittsfield, Mass., Geo. E. Frothingham, Michigan University, and H. H. Kimball, Minneapolis, Minn., for valuable aid; also to Dr. H. S. Cheever, of the University of Michigan, who, while Demonstrator of Anatomy in that institution in 1867–68, very kindly afforded me extensive opportunities for experimentation. As I have already said, these observations have abundantly confirmed the truth of the propositions already laid down, and which in general terms answer the two questions under consideration. I shall now state, as briefly and concisely as possible, the points

of greatest interest, both pathological and therapeutical, in relation to the several articulations, as noticed upon the subject stripped of muscles.

The Shoulder.—In this articulation the three luxations downward, forward and backward are readily produced by dividing the corresponding portions of the capsule to an extent sufficient to admit of the passage of the head of the humerus through the opening, when it is found that if the scapula and chest are covered with canvass sufficiently tense to represent the tegumentary, fascial and muscular coverings in the antero-posterior varieties, the positions that the limb assumes on the living subject in the several forms of this injury are accurately produced; and that if the limb is carried in such a direction as to relax the undivided portion of the ligament, reduction is at once effected.

The proper mode of procedure for restoring the displaced *caput humeri* may be stated in very few words. Raise the arm to a horizontal position, whatever the position of the head of the bone; then, if the head be in the axilla, make extension with a slight rotatory motion directly outward. If there is any delay in reduction carry the arm slowly upward, continuing the extension, if necessary, until it attains a perpendicular position. If the luxation be primarily forward under the clavicle, the elbow, already pointing somewhat backward, is carried still farther backward, gentle extension being made as in the first instance, until the posterior ligamentous band is so far relaxed that the bone slides into place. If the anterior position is only secondary to an axillary displacement, then as, by the movement last described, the head glides into the axilla, the limb is to be carried upward, outward and forward a little, and the reduction to be completed as in case of primary dislocation downward. If the luxation be the very rare one posteriorly upon the border or dorsal surface of the scapula, then the elbow, now pointing somewhat forward, is to be carried still further forward and upward also, for the reason that to attain this position the head of the bone has passed *downward* as well as backward, and the proper route through which the displaced bone returns to its socket is the one it travelled in leaving it.

But I have been often asked why it is, if these views are correct, that in the common dislocation into the axilla reduction is so often effected with facility by the ordinary method of extension downward, using at the same time the arm as a lever over a fulcrum of some sort placed in the axilla. The answer is easy. Without noticing at present the cases of *extraordinary* laxity of the capsule, of which I shall speak further on, it is to be remembered that the scapulo-humeral articulation is more prone to luxation than any other. With its shallow glenoid cavity, which is hardly a cavity at all, and its roomy lax capsule admitting of such a wide range of motion, the head escapes with great facility, the limb constantly assuming, within the limits of ordinary motion, positions in which the axis of the humerus points over the edge of the shallow cup in which its articulating extremity rests, when but little more force is requisite for the production of the displacement than that which will tear the ligament; and it is for the reason that the capsule is of such amplitude, and that the glenoid cavity is so small in diameter and lacks the bony ridge which so securely guards the head of the femur, that in this injury the abduction is oftentimes so slight, the arm hanging almost straight by the side; and these same conditions facilitate reduction. Yet it is true that, while as compared with other joints the amount of tension of the untorn capsule is small, requiring proportionally less relaxation, it nevertheless exists as the main opposing force, which must be annulled either by tearing or relaxation before reduction can take place. How, then, if it is not torn, is the requisite relaxation effected in the common procedure referred to? I answer, by the accommodation of the scapula to the surgeon's efforts. Were this bone immovable this method would be unavailing, unless sufficient force were used to complete the laceration of the ligament; but it is very mobile, and as the surgeon, putting his heel in the axilla, makes extension downward, the shoulder-blade glides forward upon the thorax, and as the extending force is continued, and the humerus used it may be as a lever over the axillary fulcrum, the posterior and upper border of the bone is tilted from the ribs, the glenoid cavity being turned in the opposite direction forwards and *inwards*, until by this *change of position* the tension of the ligament is so far relieved as to allow the head of the bone to return to its place. But while, for the reasons given, the old method often succeeds, it always involves *unnecessary* force, and oftentimes an amount that seriously injures the axillary vessels and nerves, and occasionally it fails altogether.

With the manipulations I have described, I believe the surgeon will never fail in a re-

cent dislocation; the force required is trivial, and as no injury is done to the parts, the danger of subsequent inflammation is much diminished.

The Elbow.—By dividing the posterior and lateral portions of the capsule surrounding this joint and flexing the limb, but little force is required to drive the heads of the radius and ulna into their ordinary position in the backward luxation on the living subject. It is then found that the anterior fibres of the ligament hold the forearm in the position which it ordinarily occupies in this accident. The outward and inward varieties of the backward luxation are obtained by dividing in addition the inner or outer portion of the anterior ligament, the inner to produce the outward and the outer to produce the inward form.

If the anterior and lateral ligaments are divided, leaving the posterior bands intact, after freeing the olecranon, the backward dislocation can be produced by forcibly extending the forearm upon the arm, at the same time pushing it upward. In this case the forearm, instead of being flexed more or less upon the arm, as in the common form of injury, remains extended, nor can it be flexed to any extent without completing the division of the ligament posteriorly.

In the first and common variety in which the anterior part of the capsule is untorn, reduction is effected by flexing the limb and making pressure upon the anterior surface of the forearm, near the elbow, while an assistant steadies the arm—the same indication, *i. e.* relaxation of the untorn ligament, is fulfilled by the ordinary plan of flexion over the surgeon's knee—but in the rare form of luxation in which the posterior portion of the capsule remains untorn, the forearm being extended upon the arm, and not admitting of flexion, reduction is accomplished by extending the limb still more, or if necessary, bending it a little backward, when with a little lateral or rotatory motion the deformity is readily relieved.

I have referred in another part of this paper to two cases of dislocation of the elbow, one in my own practice and another seen *post mortem* by a medical friend, both of which, and especially the latter, gave decided evidence to my mind that here, as elsewhere, we have to deal principally with untorn ligament.

I have since seen a case in the practice of the late Prof. Timothy Childs, of Pittsfield, Mass., in which the man's arm being caught in a belt, the forearm was badly lacerated, and the entire group of muscles around the humerus, except a small portion of the triceps, were torn through, exposing the bone midway between the elbow and shoulder; the elbow joint was not exposed, but was dislocated backward and outward. At my suggestion it was undisturbed until after amputation at the shoulder, when we found that myself making the extension and Dr. Childs the counter-extension in the line which the forearm occupied, our united strength was insufficient to reduce it; but I at once effected reduction by the manipulation I have described. An examination revealed a considerable portion of the anterior ligament untorn. Unfortunately, the prejudices of friends would not allow us to retain the specimen. Such cases need no comment.

Of the unusual condition in which the ligamentous tension is posteriorly, I have seen two cases in the living subject; one in private practice, and one which was brought to my clinic in Michigan University, by Dr. Andrews, of Detroit, and examined with me by Prof. Armor. In both instances the limb was straight, and the malposition of the bones easily detected. In the first case I very readily rectified the displacement by bending the forearm backward a little, and making gentle extension, the patient being etherized.

In the second case the luxation had existed several weeks, and the patient declined interference.

The Wrist.—Antero-posterior dislocations of the carpus upon the bones of the forearm are produced by dividing corresponding portions of the investing ligaments, and forcing the bones into malposition. But the capsule is so lax and the articulating surface so small, that the tension is slight, and the reduction of this *exceedingly* rare displacement is effected with but little manipulation—a fact rather difficult to explain, I think, upon the old theory, when we reflect what powerful groups of muscles send their tendons below this articulation for insertion.

Metacarpo-phalangeal Articulations.—Luxations of these joints are, in a majority of cases, readily reduced by simple extension, for the reason in some cases that the capsule is entirely torn, in others that it is inordinately large, allowing of displacement without tension, so that in either the only resistance is muscular. But a minority of these cases have always been recognized as exceedingly and mysteriously difficult to manage. Every now and then a case is met with where the most powerful extending force compatible with the safety of the

member is necessary, and various contrivances have been instituted for the purpose of making the extension efficient. Even then it sometimes fails. An explanation of these cases is simply impossible upon the theory of muscular resistance ; but an examination of these articulations stripped of everything but the capsules reveals the fact that untorn ligament determines, here as everywhere, the deformity, and constitutes the resistance, and the simple rule is here, as in all luxations, *relax the untorn ligament.* Prof. Crosby, senior, of Dartmouth College, many years ago described a method of reduction in these difficult cases by forcibly bending the phalanx backward upon the dorsum to a right angle with the metacarpal bone, when, by pressure with the thumb or fingers, the head of the phalanx is made to slide forward into its place. This manœuvre, which is usually effectual, owes its success to the fact that it relaxes tense ligament, but that it may prove efficient it is necessary that the capsule should be torn in a certain direction, while at the same time something depends upon the original size of the ligament, and it therefore happens occasionally, as has been the case in my own and the hands of several surgeons of my acquaintance, that this procedure fails, and it fails in these rare instances because in those particular cases it does not relax the offending fibres. There is a great difference in different individuals in the size of these articulating surfaces and of the investing capsule, the capacity of the latter often being much greater than is requisite for the ordinary range of motion. Bearing this in mind, suppose a dislocation of the metacarpo-phalangeal joint of the index finger, the base of the phalanx resting on the dorsal surface of the metacarpal bone. Now it may be that in reaching this position the bone has completely lacerated the capsule. If so, simple extension will suffice for reduction. If the bone has escaped through a rent in the dorsal portion of the capsule, leaving a portion of palmar ligament intact, this will of course be upon the stretch more or less, according to its length, and it is upon its length that the success of Prof. Crosby's method depends. If the untorn palmar portion of the ligament be long enough to admit of the movement practised in this method, reduction will be accomplished. If the tense fibres are too short for this, then the manipulation will fail, unless sufficient force is used to lacerate them. It is probable that this laceration often occurs when but a small portion of the capsule remains uninjured, as the lever power applied is very considerable. In this class of cases the better manipulation, because it constantly relaxes the palmar ligament, is, *flexion* of the finger upon the palm, at the same time making extension.

Again, it may be that the capsule is so roomy as to allow the head of the phalanx to rest upon the metacarpal covered in by the dorsal ligament, with or without rupture of the anterior portion. In this case, if simple extension does not readily overcome the difficulty, Prof. Crosby's method will. And yet again, in these different conditions of the antero-posterior ligaments, certain remaining fibres of the lateral ligaments may require some modification of the manipulation to relax them.

A patient examination of a large variety of subjects will convince any one of the importance of careful attention to these several points, and of studying thoroughly, in a difficult case, the locality and extent of ligamentous rupture, and the degree of tension of the remaining portion. This may be readily ascertained by determining in which directions the finger moves, passively, most easily. The distal end will be carried most readily away from the side where the rupture exists, and with proper attention to these conditions and manipulations, in accordance with them. I believe that in recent cases subcutaneous division as so often practised by some surgeons will never be necessary, unless possibly in some peculiarly shaped and small-sized aperture, which in this joint I can hardly conceive possible.

I once saw a case with Dr. Oliver Brewster, of Pittsfield, in which he had tried extension and Crosby's method without effect, and was about to tenotomize, as he told me he had done several times in other cases, when it was found that by varying the procedure so as to relax some lateral fibres, reduction was accomplished, and he afterward told me that he believed if he had to go over the ground of the former cases again he could dispense with the knife. Whether or not the knife be occasionally indispensable, it is important to notice the fact that, when used, so far as I know, no surgeon thinks of dividing *tendon*, but finds it sufficient to divide some *ligamentous* band ; thus practically, whether consciously or not, admitting the truth, for this locality at least, of the first proposition stated in this paper.

The Hip.—In the luxations of this articulation, the questions under discussion receive most emphatic answer. I have already referred to Prof. Gunn's able teachings and decisive demonstrations, with re-

gard to the upward and backward displacements of the *caput femoris*. I have only to add that the dislocation forward upon the pubis and downward upon the thyroid foramen, and the various modifications of these, are produced with as much accuracy and fidelity as regards symptoms as are the luxations upon the *dorsum ilii*—the difference in operating being that we divide that portion of the capsule in the direction of the luxation, or in other words, opposite the point where the head of the femur is to rest. This fact is, however, to be borne in mind. With the varying capacity of the capsule in different subjects, I have often found it necessary to divide the ligament more extensively than is necessary to merely allow of the passage of the head of the bone, in order to produce these deformities in a well-marked degree, and sometimes in making the luxation downward to cut the upper part of the ligament directly opposite the opening made for the escaping caput; and in the pubic dislocation I have found a corresponding manœuvre sometimes necessary. It is not *necessary* in either instance to divide the anterior and stronger portion of the capsule. I do not, in fact, feel quite clear as to what portion of the ligament is constantly or generally torn, or I might better say how extensively it is usually torn in these luxations. That accomplished and renowned anatomist, Prof. C. L. Ford, my former teacher and present colleague, who yearly demonstrates to his classes the influence of the untorn, anterior part of the capsule in the iliac displacements, long ago called my attention to the importance of considering the great difference in strength between the anterior and other portions of the capsule; a fact noticed by the various anatomical writers. In 1864, when Dr. Lyon, of Palmer, Mass., then Demonstrator of Anatomy in Berkshire Medical College, was examining a hip joint in which I had cut away all the capsule except the anterior portion, he, after considerable effort, succeeded in throwing the head of the bone both upon pubis and thyroid foramen, producing the characteristic symptoms without injuring the anterior band.

In a compound dislocation forward examined *post mortem* by myself and the late Dr. Geo. Collins, the anterior and lower portion was untorn, as was also a band stretched above the neck, attached to the upper edge of the acetabulum. In a man who was killed by falling from a great height, and who, otherwise horridly mutilated, sustained a downward luxation, it was found by Dr. F. K. Paddock, of Pittsfield, Mass., and myself, in company with several medical men, that the inner and anterior portion was intact; also that a band ran from the posterior part of the neck to the posterior lip of the acetabulum. All these facts make me a little uncertain, without further investigation, which I hope soon to give the subject, as to the exact locality and usual extent of ligamentous injury in the several varieties of this injury. This is an important field for study. But while I feel somewhat uncertain as to the usual condition of the anterior portion of the capsule in these injuries, I am none the less certain of the application of the general principles I am endeavoring to establish.

In reduction of the iliac displacements I have used Reid's manipulation, now familiar to all surgeons, with satisfaction, and it must be admitted that it relaxes the untorn portion of the capsule; but I have found Prof. Gunn's rule equally efficient, and, as being still simpler, I prefer it—that is, *adduct the limb still further and invert still more*, when with a little extension the head returns to its socket.

I have reduced the pubic and thyroid forms of luxation, with my own hands, in accordance with the following rules:—

In the *pubic* or *upward* and *forward luxation, abduct, evert and extend the limb, carrying it backward.*

In the *dislocation downward* upon the *obturator foramen, abduct and evert the limb generally, carrying it backward.* In some cases the ligamentous tension is such that the latter movement is unnecessary, and a forward movement, with strong abduction, is better. It will be noticed that these movements, as those in the luxations upon the dorsum ilii (by which I mean the dorsal and so-called ischiatic), carry the limb to the position it must necessarily have occupied before the head of the bone could escape; and a most significant fact is, that this direction is the only one in which the limb can be carried without extraordinary, or at least unnecessary force. The intermediate forms of luxation, if I may use the term, depending upon variations of the ordinary ligamentous laceration, are to be reduced by the same general rules, varied according to the position of the limb which indicates the portion of the capsule on the stretch, *it being always borne in mind that this* determines the character of the deformity.

The Knee.—Partial dislocations of this joint are sufficiently common without ligamentous laceration, as we see oftentimes in the remarkably lax capsules of "hysterical knees"; and partial displacement

may occur, the one condyle occupying the place of its fellow, with partial or complete rupture of ligament on one side. In these cases reduction is effected by extension, the leg being at the same time adducted or abducted upon the thigh—adducted if the condyles are thrown outward, and abducted if the reverse position obtains. Complete dislocations of the knee, however, are rare. Yet they do happen occasionally, and nowhere in the body do the views set forth in this paper find more forcible illustration than in these injuries. When we consider the powerful group of muscles whose tendons surround and find insertion below this joint, and the marked prominences and depressions pertaining to the articulation, it may certainly be claimed that in complete luxation of the condyles of the femur upon the tibia, the conditions for "muscular resistance" are fully present. And yet the fact has been, in my own cases and in all those of which I can find a record, that the reduction has been *remarkably easy*. I have had two cases in my own practice, and both were readily reduced with my own hands, the patients being etherized. In the first instance, so readily was replacement effected that I fully sympathized with my friend Dr. O. S. Root, of Pittsfield, Mass., who saw it with me, when he remarked that if he had thought it would "go in so easy" we would have studied the rare phenomenon a little more before attempting reduction. The second case was equally amenable to treatment. Now, how upon the old and common theory can these things be explained? If it be said that ruptured tendons might give a solution, it would be very difficult to reconcile this assumption with another remarkable feature of my own and other reported cases (and which has an important bearing upon the influence of complete laceration of capsule upon the reparative process), which is, that these cases recover with wonderful rapidity. My first case walked one quarter of a mile to my office, using only a cane, and with hardly a limp, in three weeks from the day of his injury; and this although he sustained a severe scalp wound and an amputation near the shoulder. The second case walked easily in four weeks.

But upon the ground that difficult reduction implies ligamentous tension, all becomes plain; for the articular surfaces are here expanded to such size in proportion to the laxity of their ligamentous investments, that *I have never found it possible upon the cadaver to produce a complete dislocation without entire division of the ligaments around the joint*, so that there is no untorn portion left to be put on the stretch in these accidents.

I have thus briefly and in general terms stated the results of my investigations upon this subject. Much remains to be done in detail in the critical study of the various dislocations in the light of the theory here advanced, and, I could hope, established; but while more minute knowledge shall render our work still more easy and certain, I am confident that an adoption of the general principles I have laid down will rob surgical practice of much that has been unpleasant and formidable. For myself I can say that, in a practice of fifteen years, in which it has been my lot, I think, to see a fair proportion of luxations, I have never failed, *in a recent dislocation*, with the patient etherized, to relieve the deformity without any aid except from counter-extension; and I am sure this has been from no unusual skill on my part, but simply due to the recognition of ligament instead of muscle as the agent with which I had to deal. I have been unusually fortunate in escaping those rare cases of small and peculiarly shaped rent in the capsule which, buttoning around the neck of the bone, sometimes necessarily embarrasses the surgeon. In the only case where I diagnosticated such a condition—a backward and upward dislocation of the head of the femur—I somewhat timidly and very cautiously used the femur as a lever, forcibly flexing and extending the thigh, thus endeavoring to enlarge the opening, which I apparently accomplished, as afterward the bone returned readily to its socket upon carrying the limb across the sound one, extending and inverting it. I say timidly, for I am not sure whether sometimes the neck of the femur might not yield before the capsule.

In addition to my own experience, I am happy to know that my pupils everywhere, so far as heard from, testify to the value of these doctrines as they test them in practice.

In conclusion, I desire to remind the reader that in this discussion neither is muscular resistance ignored on the one hand, nor on the other is it claimed that untorn ligament is always present, or, if so, is invariably an obstacle to reduction. On the contrary, for the muscles, it is admitted that they may operate with as much force—no more—in opposing the reduction of a dislocation as in the adjustment of a fracture, and in very rare cases, as in tetanic conditions, this may be extreme; but it is claimed that as an almost universal rule the surgeon's personal efforts are suffi-

cient to overcome this muscular contraction, while anæsthesia practically abolishes it.

Again, it is admitted that very often the ligaments are entirely torn through, leaving nothing but muscles to encounter; and again, that the capsule in rare cases is so lax as to admit of complete displacement without tension of the untorn portion, or even without any rupture at all. This is important to remember in studying this subject upon the dead body. I have seen subjects upon which it was hardly possible to produce a complete luxation of any joint in the body without entire severance of the capsule, so short and tense were the ligaments in proportion to the unusually large articular surfaces; and again, I have found the capsule of the hip, even, so large and roomy that in one instance, much to my surprise, I was unable to demonstrate the position of the limb and the resistance of the untorn ligament in the upward and backward dislocation. In this instance, but for the teres ligament, I think spontaneous luxation would have been possible during life without rupture of the capsule at all. But it is affirmed that when the capsule is entirely destroyed or is extraordinarily loose, there is no *great* opposing force to overcome, and that the fact of easy reduction by extension in the position which the limb occupies is proof that one or the other of these conditions exists; and it is further claimed that where any great amount of resistance is present, with the exceptions already made, it is ligamentous, and that before reduction can be effected the offending fibres must either be ruptured or relaxed. The laceration can be accomplished by brute force only, while the requisite relaxation can be attained by intelligent manipulation.

Within a few days after the completion of the foregoing paper, in October last, I received the excellent and classical work on "The Hip," recently published by Prof. Henry J. Bigelow, of Boston, which I have read with pleasure and profit. It came early enough to give me the pleasant opportunity of giving him full credit for his views in a discussion upon this subject in the Cumberland County Medical Society, and I have until now hesitated whether or not to re-write some portions of my paper. But, upon consideration, I prefer to publish the article as originally prepared. I am most happy to learn, what I regret not to have known before, that this accomplished surgeon has for several years recognized and taught the doctrine of ligamentous resistance as applying to the several dislocations of this joint—I shall rejoice to learn that he extends its application to the other articulations—and he maintains that it is the anterior portion of the capsule, with its strong ilio-femoral reinforcement, which he describes as a distinct structure under the name of the Y ligament, that is the constant factor determining the position of the limb and opposing the reduction in the various forms of luxation. I have already alluded to my indebtedness to Prof. Ford for suggestions upon this point, and to doubts that had arisen in my mind in connection with my own and Dr. Lyon's observations, and I have therefore been especially interested in this portion of Prof. Bigelow's book; but while it is undoubtedly proven that the ilio-femoral ligament *may* accomplish all this, I do not feel quite sure that it is so constantly the offending agent to the exclusion of other portions of the capsule, as the author maintains. If so, I do not see clearly how the pubic and thyroid dislocations were so easily reduced in my own cases by the manipulations I have described. Nor is the anterior portion of the capsule always so dense and strong. It is only yesterday that I found the ilio-femoral bands almost entirely wanting. The subject was a female, in a good state of preservation, upon which I was demonstrating the "ligamentous theory" before the class of the Portland School for Medical Instruction, and having cut away the posterior and upper portion of the capsule, I found myself able with my own strength, an assistant making counter-extension, to tear the anterior portion by simple extension. This was witnessed not only by the class, but by Drs. Foster and Weeks of this city, Bates of Yarmouth, Hall of Cumberland, and other members of the profession. This of course was an exceptional case, but, together with the reasons already given, makes me somewhat doubtful whether the "Y ligament" may not be more frequently torn than Dr. Bigelow supposes. Upon this question hinges another, as to the propriety of the general rule for flexing the thigh in all cases. But I have no disposition to discuss these points without farther observations, and can only hope that the attention of the profession will be so drawn to them that they may be speedily settled beyond question.

Upon the enlargement of the capsular opening by circumduction, Prof. B.'s experiments seem conclusive, and have given me great relief; for it seems well established that in a healthy bone the capsule will yield without danger of fracture.

January 27, 1870. W. W. G.